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# The Mean Right Ascensions and Proper Motions of 254 Stars

A Thesis Presented to the Faculty of Philosophy of the University of Pennsylvania

BY

H. B. EVANS

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In Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy

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## Introduction.

The object of the present discussion is primarily the derivation from all available data of definitive values of the Right Ascensions and Proper Motions of 254 stars. These stars constitute the star list used by Professor C. L. Doolittle in the investigation of the variation of latitude at the Sayre Observatory of Lehigh University in the years 1876 to 1893 inclusive. For use in the final discussion of these observations the Declinations have been investigated by Professor Doolittle. It is hoped that the results of the latter discussion may prove valuable in lines of investigation other than that for which it has been executed. With this end in view, the Right Ascensions have here been reduced according to the same method, and it is hoped with the same care and thoroughness, as in the case of the Declinations. For the sake of completeness, and with the permission of Professor Doolittle, the Declination data and results are given with those of the Right Ascensions.

## *Authorities.*

In the list of catalogues employed it is not thought necessary to give more than the names of those which are generally well known. The works themselves should be found in every astronomical library. In case they are not readily accessible, further information regarding them may be obtained from Newcomb's *New Catalogue of Fundamental Stars*, Davis' *Declinations and Proper Motions of Fifty-six Stars*, and Boss' *Declinations of Fixed Stars.*

In case of all catalogues for which Auwers gives systematic corrections, these have been applied. In other cases such corrections have been derived indirectly through the systems of Newcomb or Boss. Where recourse has been had to other methods, mention of the process is found in the accompanying notes. In some of the recent catalogues the uncorrected places have been employed. For the sake of completeness and uniformity,

however, such corrections have been applied in all cases where they were available, although it would seem that any one who has had occasion to examine somewhat closely into this subject, must agree with Newcomb's conclusion that the correction for systematic errors has in recent times been carried too far.

As the Declinations were reduced in advance of the Right Ascensions, a number of catalogues became available for the latter which were not employed for the former. It is also to be observed that the list embraces several catalogues which give one coordinate only. Where the name is followed by the symbol $\alpha$, the catalogue has been employed only for the Right Ascensions; when followed by the symbol $\delta$, only for the Declinations.

In the explanatory notes $s$ designates the systematic correction in Right Ascension; $s'$ designates the systematic correction in Declination; $p$ designates the weight of the Right Ascension; $p'$ designates the weight of the Declination; $t$ the mean date of observation. The system of weights employed will be spoken of in connection with the method of reduction.

## *List of Catalogues.*

1. BRADLEY. 1755. Neue Reduction der Bradley'schen Beobachtungen aus den Jahren 1750 bis 1762. Von Arthur Auwers. St. Petersburg, 1888.
2. MAYER. 1755. Tobias Mayer's Sternverzeichniss nach den Beobachtungen auf der Göttinger Sternwarte in den Jahren 1756 bis 1760. Neu bearbeitet von Arthur Auwers. Leipzig, 1894.
3. FEDORENKO'S Lalande. 1790. Positions Moyenne pour l'Epoque de 1790,0 des Etoiles Circumpolaire, dont les observations ont été publiées par Jérôme de Lalande dans les Mémoires de l'Académie de Paris de 1789 et 1790. Par Ivan Fedorenko. St. Pétersbourg, 1854. $s = \frac{1}{2}$ (Åbo + Bessel's Bradley); $p$ same as 2; $t$ from Histoire Céleste.
4. LALANDE. 1800. A Catalogue of those Stars in the Histoire Céleste Française of Jérôme de Lalande for which tables of reduction to the epoch 1800 have been published by Prof. Schumacher. Francis Baily, Esq. This catalogue was used for a few stars where other early authorities were wanting or doubtful. For declinations the places were taken directly from Bally's Catalogue. $p' = 0.1$. For right ascensions Von Asten's tables were used. $p$ same as 2; $t$ from Histoire Céleste.
5. BOSSERT ($\alpha$). 1800. Supplément à l'Histoire Céleste de Lalande. Catalogue de 3950 étoiles ramenées à l'équinoxe de 1800. Par M. J. Bossert. Paris, 1893. $p$ same as 2.
6. D'AGELET. 1800. Reduction of the Observations of Fixed Stars made by Joseph Lepaute d'Agelet at Paris in 1783–1785, with a catalogue of the Corresponding Mean Places referred to the equinox of 1800,0. By B. A. Gould. Washington, 1866.

   $s = 0^s.12$.
   $s' =$ Piazzi $- 1''.42$ $0^h$ to $XII^h$.
   $s' =$ Piazzi $+ 1''.22$ $XII^h$ to $XXIV^h$.
   $p$ same as 2.
7. PIAZZI. 1800. Præcipuarum stellarum inerrantium Positiones Mediæ Ineunte Sæculo xix ex observationibus habitas in Specula Panormitana ab anno 1792 ad annum 1813. Panormi, 1814. $t$ from original observations. Right ascensions of stars north of 65° declination not used.
8. GROOMBRIDGE. 1810. A Catalogue of Circumpolar Stars deduced from the observations of Stephen Groombridge at Blackheath Observatory. Edited by George Biddell Airy, Esq. London, 1838.

9. Dorpat ($a$). 1814. F. G. W. Struve. Observationes Astronomicas Institutas in Specula Universitatis Cæsareas Dorpatensis, Vol. I.
10. Dorpat ($a$). 1815. Catalogus I.
11. Koenigsberg ($a$). 1815. Bearbeitung von Bessels Beobachtungen am Dollond'schen Mittagsfernrohre in den Jahren 1813–19 Von Dr. Fritz Cohn. Königsberg Beobachtungen, 39 Abtheilung. $s = 0$.
12. Weisse-Bessel ($\delta$). 1825. Bessel's Zone observations reduced by Maximillian Weisse. This was used for a few declinations, usually those for which early determinations were wanting. $p = 0.1$.
13. Schwerd-Oeltzen ($a$). 1828. The positions were taken from Carrington, No. 43.
14. Åbo. 1830. DLX, Stellarum Fixarum Positiones Mediæ ineunte anno 1830 ex observationibus Aboæ habitas deduxit. Fredr. Guil. Aug. Argelander. Helsingforsiæ, 1835. $t$ from Davis, Ast. Journal, No. 328.
15. Pearson ($\delta$). 1830. Dr. Pearson's Catalogue of 520 Stars within 6° North and South of the Ecliptic. Memoirs R. A. S., Vol. xv, p. 97. London, 1846. $p' = 0$; 0.1. $s' = 0$.
16. Cambridge. 1830. Airy's First Cambridge Catalogue. Memoirs R. A. S., Vol. xi. London, 1859.
17. Fallows ($a$). 1830. Results of Observations made by the Rev. Fearon Fallows at the Royal Observatory, Cape of Good Hope, in the Years 1829-31. Memoirs R. A. S., Vol. xix, p. 1.
18. Pond. 1830. A Catalogue of 1112 Stars from Observations at Greenwich from 1816 to 1833. London, 1833. $t$ was obtained from the original observations in Greenwich Yearly Results.
19. Struve. 1830. Stellarum Fixarum imprimis duplicium et multiplicium pro epocha 1830. Petropoli, 1852.
20. Wrottesley ($a$). 1830. A Catalogue of the Right Ascensions of 1318 Stars. By John Wrottesley, Esq. Memoirs R. A. S., Vol. x.
21. Montojo ($a$). 1835. Mean Positions of the Stars contained in "Mr. Baily's Address" as determined at San Fernando. Memoirs R. A. S., Vol. xii, p. 238.
22. Madras. 1835. A General Catalogue of the Principal Fixed Stars from Observations made at the Honorable East India Company's Observatory at Madras in the years 1830–43. By Thomas Glanville Taylor. Madras, 1844.
23. Rümker. 1836. Mittlere Oerter von 12,000 Fixsternen für den Anfang von 1836, abgeleitet aus den Beobachtungen auf der Hamburger Sternwarte von Carl Rümker. Hamburg, 1852.
24. Köller ($a$). 1838. Extract from a letter from M. Marian Köller, Director of the Observatory at Kremsmünster . . . . accompanying a Catalogue of 208 Stars. Memoirs R. A. S., Vol. xii, p. 373.
25. Armagh. 1840. Places of 5345 Stars observed from 1828 to 1854 at the Armagh Observatory. By Rev. T. R. Robinson. Dublin, 1859.
26. Santini ($\delta$). 1840. A Catalogue of 1677 Stars included between the Equator and Ten Degrees of North Declination, observed at the Royal Observatory of Padua. By Prof. Giovanni Santini. Memoirs R. A. S., Vol. xii, p. 273. $p' = 0$; 0.1; 0.2.
27. Cape of Good Hope. 1840. The Cape Catalogue of Stars deduced from observations made at the Royal Observatory, Cape of Good Hope, 1834 to 1840, and reduced to the epoch 1840 under the superintendence of E. J. Stone. Cape Town, 1878.
28. Gilliss ($a$). 1840. Catalogue of Twelve Hundred and Forty-eight Stars observed at Washington between October, 1838, and July, 1842. Washington, 1846.
29. Greenwich. 1840. Catalogue of 2156 Stars formed from the Observations made from 1836 to 1841 at the Royal Observatory, Greenwich. London, 1849.
30. Oeltzen's Argelander ($a$). 1842. Annalen der K. K. Sternwarte in Wien. Bd. i. Wien, 1851. $s$ same as Åbo; $p$ same as Rümker; $t$ from original zones.
31. Greenwich. 1845. Catalogue from observations from 1842 to 1847.
32. Paris. 1845. Catalogue de l'Observatoire de Paris. Étoiles observées aux Instruments Méridiens de 1837 à 1853.
33. Poulkova ($a$). 1845. Étoiles observées occasionnellement. St. Pétersbourg, 1875.
34. Radcliffe. 1845. The Radcliffe Catalogue of 6317 Stars chiefly Circumpolar reduced to the Epoch 1845. Formed from the Observations made at the Radcliffe Observatory under the Superintendence of Manuel John Johnson. Oxford, 1860.

35. Oudemans ($\delta$). 1849. Dissertatio Astronomica Inauguralis exhibens Observationes ope Instrumenti Transitarii partabilis institutas. . . . . Lugdini-Batavorum, 1852.
36. Cape of Good Hope. 1850. Catalogue of 4710 Stars for the Epoch 1850, from Observations made at the Royal Observatory, Cape of Good Hope, during the Years 1849 to 1852, under the Direction of Sir Thomas Maclear.
37. Gilliss. 1850. A Catalogue of 1963 Stars and of 290 Double Stars observed by the U. S. Naval Astronomers during the Expedition to the Southern Hemisphere. Appendix i to Washington Yearly Observations for 1868.
38. Greenwich. 1850. Catalogue of 1576 Stars formed from Observations made during Six Years, from 1848 to 1853, at the Royal Observatory, Greenwich.
39. Madras. 1850. A Subsidiary Catalogue of 1440 Stars selected from the British Association Catalogue, reduced to Jan. 1, 1850, from Observations made at Madras in the Years 1849–53. Madras, 1854.
40. Rümker. 1850. Neue Folge der mittleren Oerter von Fixsternen für den Anfang von 1850, abgeleitet aus den Beobachtungen auf der Hamburger Sternwarte von Carl Rümker. Hamburg, 1852–59.
41. Sonntag($a$). 1850. Mittlere Oerter für 1850 von Vergleichsternen zum Cometen I 1850. Ast. Nach., Bd. xxxiv. $p$ same as 32 ; $s = .050$.
42. Wrottesley ($a$). 1850. A Catalogue of the Right Ascensions of 1009 Stars contained in the Catalogue of the British Association for the Advancement of Science. . . . . By Lord Wrottesley. Memoirs R. A. S., Vol. xxiii.
43. Carrington. 1855. A Catalogue of 3735 Circumpolar Stars observed at Redhill in the years 1854, '55 and '56 and reduced to the Mean Position for 1855. By Richard Christopher Carrington. $p$ same as 13.
44. Madras. 1855. A Catalogue of 317 Stars . . . . deduced from Observations at Madras. Memoirs R. A. S., Vol. xxii.
45. Moesta. 1855. Observaciones Astronómicas hechas en el Observatorio Nacional de Santiago de Chile en los Añas de 1853, 1854 y 1855. Vol. i. Santiago, 1859.
46. Moscow. 1855. Catalogue des étoiles observées par M. Drachoussoff. Annales de l'Observatoire de Moscow, Vol. vi. $s$ same as Nautical Almanac ; $p$ same as 53.
47. Poulkova. 1855. Positions Moyenne déduites des observatious faites au cercle méridien 1840–1869 et réduites à l'époque 1855, 0. Observations de Poulkova, Vol. viii. St. Pétersbourg, 1889.
48. Cape of Good Hope. 1860. The Cape Catalogue of 1159 Stars, deduced from Observations by Sir Thomas Maclear at the Royal Observatory, Cape of Good Hope, 1856 to 1861. Cape Town, 1893.
49. Santini ($\delta$). 1860. Posizioni Medie di 1,425 Stelle, dedotte dal osservazioni fatte dal defunto Prof. Trettenero 1861–65. Venezia, 1870. $p' = 0$ ; 0.1 ; 0.2.
50. Greenwich. 1860. Seven Year Catalogue of 2022 Stars deduced from Observations extending from 1854 to 1860 at the Royal Observatory, Greenwich.
51. Moscow. 1860. Resultate aus der Zonen-Beobachtungen am Meridian Kreise der Moskauer Sternwarte während der Jahre 1858-69. I Zone 0°–4°. Memoirés de l'Académie Impériale des Sciences de St. Pétersbourg, viii Série : Classe Physico-Mathematique, Vol. I, No. 5. $s$ same as Poulkova, 1855 ; $p$ same as 53.
52. Paris. 1860. Catalogue de l'Observatoire de Paris. Etoiles observée de 1854 à 1867.
53. Radcliffe, 1860. Second Radcliffe Catalogue, containing 2386 Stars deduced from observations extending from 1854 to 1861 . . . . Oxford, 1870.
54. Yarnall. 1860. Catalogue of Stars observed at the United States Naval Observatory during the years 1845 to 1877. Third edition revised. . . . . Washington, 1889.
55. Poulkova ($\delta$). 1862. Observations faites à l'Instrument des passages établi dans le Premier Vertical. Oom. Observations de Poulkova, Vol. iii, pp. 223–238.
56. Greenwich. 1864. New Seven Year Catalogue of 2760 Stars, deduced from Observations extending from 1861 to 1867 at the Royal Observatory, Greenwich.
57. Brussels. 1865. Catalogue de 10,792 Étoiles observée à l'Observatoire Royal de Bruxelles de 1857 à 1878 . . . . Par Ernest Quetelet, Bruxelles, 1887.

58. Poulkova ($a$). 1865. Ascensions droites Moyenne des étoiles occasionnellement observées pour 1865,0. Observations de Poulkova, Vol. xii.

59. Schjellerup($a$). 1865. Stjernefortegnelse indeholdende 10,000 Positioner af Teleskopiske Fixstjerner imellem — 15 og + 15 Gradus Deklination. Kjøbenhavn, 1864. $s$ same as Nautical Almanac interpolated as follows: $s = 1860 + \frac{7}{15}$ (1875–1860); $p$ same as 53.

60. Glasgow. 1870. Catalogue of 6415 Stars for the Epoch 1870, deduced from Observations made at the Glasgow University Observatory during the Years 1860 to 1881 . . . . By Robert Grant. Glasgow, 1883.

61. Melbourne. 1870. First Melbourne General Catalogue of 1227 Stars for the Epoch 1870 deduced from Observations extending from 1863 to 1870, made at the Melbourne Observatory. Melbourne, 1874.

62. Greenwich. 1872. Nine Year Catalogue of 2263 Stars deduced from Observations extending from 1868 to 1876, made at the Royal Observatory, Greenwich.

63. Astronomische Gesellschaft Zones. 1875. These include all of this series of catalogues published, together with the places of those stars found in the Leyden, Lund and Dorpat Zones, those of the earlier and later Lund Zones being combined separately. $p$ is taken the same as Paris, '75; $p' = 1.$ throughout the series.

64. Armagh. 1875. Second Armagh Catalogue of 3300 Stars for the Epoch 1875, deduced from Observations made at the Armagh Observatory during the Years 1859 to 1883. . . . . Dublin, 1886. $p$ same as 60.

65. Becker. 1875. Resultate aus Beobachtungen von 521 Bradley'schen Sternen am grossen Berliner Meridiankreise von Dr. E. Becker. Berlin, 1881.

66. Cordoba. 1875. Catálogo General Argentino. Cordoba, 1886.

67. Dunsink. 1875. Mean Places of 321 Red Stars deduced from Observations made with the Meridian Circle at Dunsink. . . Dublin, 1882. $s = 0$; $p$ same as Paris, '75.

68. Washington. 1875. The Second Washington Catalogue of Stars . . . . prepared under the Direction of J. R. Eastman.

$s$ obtained through Newcomb's system.

| | | | |
|---|---|---|---|
| $s' = -0''.33$ | from $\delta =$ | 0 to $\delta =$ | 40° |
| $=$ .00 | | 40° | 50° |
| $=+$ .09 | | 50° | 90° |

69. Göttingen. 1875. Mittlere Oerter der in der Zonen — 0° und — 1° der Bonner Durchmusterung enthaltenen Sterne. . . . Göttingen, 1869. $s$ same as for Nautical Almanac as follows: $s = s_{1860} + \frac{8}{15}$ ($s_{1875} - s_{1860}$); $p$ same as Glasgow, '70.

70. Harvard. 1875. Catalogue of Primary and Secondary Stars observed during the years 1870–1879 with the Meridian Circle of the Harvard College Observatory. Cambridge, 1886.

71. Paris. 1875. Catalogue de l'Observatoire de Paris. Étoiles observée de 1868 à 1881.

72. Poulkova. 1875. Catalog von 5634 Sternen für die Epoche 1875.0 aus den Beobachtungen am Pulkowaer Meridiankreise während der Jahre 1874–1880 von H. Romberg. St. Pétersbourg, 1891.

73. Stockholm. 1875. Results of meridian observations found in the first five volumes of the publications of the Stockholm Observatory. $p$ same as Paris, '75.

74. Respighi ($\delta$). 1875. Catalogo delle Declinazione Medie pel 1875.0 di 1463 Stelle comprese fra i paralleli 20° e 64° nord. . . . . Roma, 1880.

75. Cape of Good Hope. 1880. Catalogue of 12,441 Stars for the Epoch 1880 from Observations made at the Royal Observatory, Cape of Good Hope, during the Years 1871 to 1879. By Edward J. Stone. London, 1881.

76. Greenwich. 1880. Ten Year Catalogue of 4059 Stars, deduced from Observations extending from 1877 to 1886 at the Royal Observatory, Greenwich.

77. Melbourne. 1880. Second Melbourne General Catalogue of 1211 Stars for the Epoch 1880, deduced from Observations extending from 1871 to 1884, made at the Melbourne Observatory. Melbourne, 1889.

78. Respighi ($\delta$). 1880. Catalogo delle Declinazione Medie pel 1880,0 di 1004 Stelle di 1ª in 6ª grandezza comprese fra 0° e 20° nord, e 64° e 90° nord. . . . . Roma, 1885.

79. Munich ($a$). 1880. Erster Münchener Sternverzeichniss erhaltend die Mittleren Oerter von 33,082 Sternen. München, Neue Annalen, Bd. i. $p$ same as 60.

80 De Ball ($\delta$). 1880. Declinationen von 200 Sternen innerhalb der Zone + 49° bis 51°, nach Beobachtungen im ersten Vertical am Passagen-instrumente der Herzoglichen Sternwarte zu Gotha. Ast. Nach., Bd. ci, 353.

81. Cape of Good Hope. 1885. Catalogue of 1713 Stars for the Equinox 1885,0 from Observations made at the Royal Observatory, Cape of Good Hope, during the Years 1879 to 1885.

82. Harzer. 1885. Resultate aus Beobachtungen am Meridiankreise der Herzoglichen Sternwarte zu Gotha. Ast. Nach., Bd. cxxvii, 170. $s = 0$; $p = \frac{1}{2}$ that of 76.

83. Kasan ($\delta$). 1885. Les Observations faites à l'instrument des passages établi dans le premier vertical. Kasan Observations for 1893.

84. Karlsruhe. 1885. Lists found in the first four volumes of the publications of the observatory. $s = 0$; $p$ same as Radcliffe, '60.

85. Washburn ($\delta$) '84, '85. 1885. Publications of the Washburn Observatory, Vol. iv.

86. Safford ($a$). 1885. The Williams College Catalogue of North Polar Stars. Williamstown, Mass., 1888.

87. Nyrén ($\delta$). 1887. Declinationsbestimmungen einiger Helleren Sterne zwischen + 18° und + 26° am Pulkowaer Verticalkreise. A. N., No. 2904, Bd. 121.

88. Cape of Good Hope. 1890. A Catalogue of 3007 Stars for the Equinox 1890 from Observations made at the Royal Observatory, Cape of Good Hope, during the Years 1885 to 1895.

89. Cincinnati. 1890. A Catalogue of 2000 Stars for the Epoch 1890. Publications of the Cincinnati Observatory, No. 13. $p$ same as Paris 75.

90. Dunsink. 1890. Mean places of 717 Stars deduced from Observations made with the Meridian Circle at Dunsink. Dublin, 1896. $s = 0$; $p$ same as 71.

91. Glasgow. 1890. Second Glasgow Catalogue of 2156 Stars for the Epoch 1890 deduced from Observations made at the Glasgow University Observatory during the Years 1886 to 1892. Glasgow, 1892.

92. Küstner. 1890. Veröffentlichung der Königlichen Sternwarte zu Bonn, No. 2. $s = 0$.

93. Radcliffe. 1890. Catalogue of 6424 Stars for the Epoch 1890. Formed from Observations made at the Radcliffe Observatory, Oxford, during the Years 1880–1893.

94. Battermann. 1895. Resulte aus Beobachtungen von 379 Anhaltsternen und 1640 durch Anschluss bestimmten Sternen, angestellt in den Jahren 1892–1897 am Grossen Berliner Meridiankreise von Dr. H. Battermann. Berlin, 1899. $s = 0$.

95. Cincinnati. 1895. Catalogue of 2030 Stars for the Epoch 1895. Publications of the Cincinnati Observatory, No. 14. $s = 0$; $p$ same as 71.

96. Tucker ($a$). 1895. Meridian Circle Observations of 310 Standard Stars. Publications of the Lick Observatory, Vol. iv. Sacramento, 1900.

97. Tucker ($\delta$). 1897. The entire list of stars was very carefully observed by R. H. Tucker, of the Lick Observatory, in the years 1896 and 1897. It was intended to publish the results of these observations in full in this connection, but the preparation of this work has been so long delayed that it now appears superfluous, in view of the fact that a much more detailed report than could be given here will appear in a forthcoming publication of the Lick Observatory. The following note is by Mr. Tucker:

"Each star was observed twice in each position of the instrument, fixed circle East and West, and "the greater part of the stars above 70° were similarly observed at both culminations.

"The places were reduced with the Declinations from the catalogue of Louis Boss, *Declinations of "Fixed Stars, U. S. Northern Boundary Commission*, 1879.

"The probable error of a single observation is ± 0″.18. The probable error of observation for the "mean of four, in the two positions is ± 0″.12, including the effect of graduation error."

The reduction to Auwers' system has been applied and the results have been employed with a uniform weight of 3.

98. Wirtz ($\delta$). 1900. Bestimmung der Deklinationen von 487 Sternen und der Polhöhe der Bonner Sternwarte aus Beobachtungen . . . . im Ersten Vertical. Veröffentlichung der Königlichen Sternwarte zu Bonn. No. 3.

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99. DUNSINK. 1900. Mean Places of 1101 Stars deduced from Observations made with the Meridian Circle at Dunsink. Dublin, 1899. *p* same as Paris, '75.

100. KÜSTNER (*a*). 1900. Veröffentlichung der Königlichen Sternwarte zu Bonn, No. 4.

### *Yearly Series.*

101. 1835-1869. EDINBURGH. Astronomical Observations at the Royal Observatory, Edinburgh.

102. 1836-1869. CAMBRIDGE. Astronomical Observations made at the Observatory of Cambridge.

103. 1862-1876. RADCLIFFE. Results of Astronomical Observations made at the Radcliffe Observatory.

104. 1862-1887. MADRAS. Meridian Circle Observations.

105. 1879-1882 (*a*). BRUSSELS. Annales de l'Observatoire Royal de Brusselles, Nouvelle Series. *s* same as Nautical Almanac; *p* same as 57.

106. 1887-1896. GREENWICH. Annual volumes.

### *Method of Reduction.*

Approximate positions for 1875 were obtained from whatever source was available. Many of these were the result of a previous reduction, and with very few exceptions the assumed places differed from the final values only by fractions of a second. The assumed proper motions were in part the result of a previous reduction, others were taken from Auwers' Bradley and other sources.

These assumed coordinates were then reduced to the epoch of the various catalogues in which the star was found, using for this purpose the formula

$$a = a_{1875} + \left[\frac{da}{dt}\right](\tau - 1875) + \tfrac{1}{2}\left[\frac{d^2a}{dt^2}\right](\tau - 1875)^2 + \tfrac{1}{6}\left[\frac{d^3a}{dt^3}\right](\tau - 1875)^3$$

$a$ being the Right Ascension or Declination of any star.

$\tau$ the epoch of the catalogue.

The formulæ for the differential coefficients for the epoch 1875, using the constants of Struve and Peters, are as follows, in which

$\alpha$ = the Right Ascension.

$\delta$ = the Declination.

$\mu$ = the Proper Motion in Right Ascension.

$\mu'$ = the Proper Motion in Declination.

$$\frac{da}{dt} = 3.^s07225 + [0.126115] \sin\alpha \tan\delta + \mu.$$

$$\frac{d\delta}{dt} = [1.302206] \cos\alpha + \mu'.$$

$$\frac{d\mu}{dt} = [5.988]\,\mu \cos\alpha \tan\delta + [4.812]\,\mu' \sin\alpha \sec^2\delta + [4.99]\,\mu\,\mu' \tan\delta.$$

$$\frac{d^2a}{dt^2} = [4.63380_n]\left(\frac{da}{dt} - \mu\right) + [5.98778]\left(\frac{da}{dt} + \mu\right)\cos\alpha \tan\delta + [4.81169]\left(\frac{d\delta}{dt} + \mu'\right)\sin\alpha \sec^2\delta + [4.9866]\,\mu\,\mu' \tan\delta + 0.^s000\,032\,210.$$

$$\frac{d^2\delta}{dt^2} = [4.63380_n]\left(\frac{d\delta}{dt} - \mu'\right) + [7.16387_n]\left(\frac{da}{dt} + \mu\right)\sin\alpha + [6.7367_n]\,\mu^2 \sin 2\delta.$$

$$\frac{d^3\delta}{dt^3} = [2.0987]\left(\frac{da}{dt} + \frac{\mu}{2}\right)\sin\alpha + [7.1639_n]\left(\frac{d^2a}{dt^2} + \frac{d\mu}{dt}\right)\sin\alpha + [3.0255_n]\left(\frac{da}{dt} + \mu\right)\frac{da}{dt}\cos\alpha.$$

The numbers enclosed in brackets are logarithms.

For $\frac{d^3a}{dt^3}$ the Right Ascension and Declination were reduced to 1825 and 1925, using for this purpose the first and second differential coefficients already computed. $\frac{d^2a}{dt^2}$ was then derived for these dates, the differences giving $\frac{d^3a}{dt^3}$ with all necessary precision. For checking these values the tables given by Gould* were employed from $0^h$ to $12^h$, neglecting proper motion. From $12^h$ to $24^h$ the tables of Oppolzer† were similarly used.

As already stated the catalogue places were reduced to Auwers' system whenever the necessary corrections were available. A correction for proper motion was also applied in all cases where the necessary data could be found.

Let $\tau$ be the epoch of the catalogue,

$t$ the mean date of observation, usually different from $\tau$,

$\mu''$ the proper motion employed in forming the catalogue,

$\mu$ the proper motion assumed in this discussion,

The correction will be $(\tau - t)\ (\mu - \mu'') = \delta_\mu \alpha$.

It is perhaps superfluous to state that both $t$ and $\mu''$ are unknown in case of many of the older catalogues.

Let $n$ be the difference between the corrected catalogue place and the assumed place, reduced as above explained to the epoch of the catalogue,

Then each catalogue furnishes an equation of the form

$$\sqrt{p}\,(\Delta\alpha + T\Delta\mu = mn)$$

In which $p$ is the weight of the catalogue place,

$\Delta\alpha$ the correction to the assumed Declination, or Right Ascension,

$\Delta\mu$ the correction to the assumed proper motion,

$T = 1875 - t$.

A least square solution gives the most probable values of $\Delta\alpha$ and $\Delta\mu$.

The method of solving the equations is one very commonly employed in cases like this and is as follows:

Let $t_0$ be the weighted mean of the catalogue epochs, or of the epoch of observation when this differs from that of the catalogue,

$t_1,\ t_2 \quad t_n$ the epochs of the respective catalogues,

$T_1,\ T_2 \quad T_n = (t_1 - t_0),\quad (t_2 - t_0) \quad (t_n - t_0)$

$\Sigma pT$ should be zero.

* *Catálogo de Las Zonas Estelares*, Appendix, Table iv, Cordoba, 1884. In using this table it must be remembered that the value of $p^3$ as given in column four should be doubled. See *Ast. Nach.*, Bd. 137, p. 295.

† *Lehrbuch zur Bahnbestimmung der Kometen und Planeten*, Vol. i, Table XII.

Then we have

$$\Delta\alpha = \frac{\Sigma pn}{\Sigma p} \qquad \Delta\mu = \frac{\Sigma pTn}{\Sigma pT^2}$$

Check $\Sigma pvv = \Sigma pnn - (\Sigma pn)\,\Delta\alpha - (\Sigma pTn)\,\Delta\mu$

$\Delta\alpha$ for 1875 will be the above $\Delta\alpha + (1875 - t_0)\,\Delta\mu$.

An example follows which will illustrate the various steps in the process:

*Star.* B A C 3140

*Assumed Coordinates and proper motion for* 1875.0.

$\alpha = 9^h\ 7^m\ 10^s.87 \quad \mu = +.0056$

$\delta = 54^\circ\ 32'\ 11''.15 \quad \mu' = +.068$

| | *Catalogue.* | $\tau$ | $t$ | *No. Obs.* | $\mu''$ | $n$ | $p$ | $pt$ | $pn$ | $T$ | $pT$ | $pTn$ | $pT^2$ | $v$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Bradley | 1755 | 54.2 | 3 | +.0056 | —0.009 | .3 | —13.74 | —0.0027 | —103.22 | —30.97 | +0.2790 | +3199.20 | —0.063 |
| 2 | Piazzi | 1800 | 04.83 | 9 | | +0.261 | .08 | + 0.39 | +0.0209 | — 52.59 | — 4.21 | —1.0962 | 220.92 | —0.300 |
| 3 | Groombridge | 1810 | 08.8 | 6 | | —0.244 | .2 | 1.76 | —0.0488 | — 48.62 | — 9.72 | +2.3668 | 471.42 | +0.208 |
| 4 | Dorpat | 1814 | 14.11 | 2 | | —0.212 | .2 | 2.82 | —0.0424 | — 43.31 | — 8.66 | +1.8444 | 376.71 | +0.179 |
| 5 | Pond | 1830 | 31.54 | 13 | | +0.070 | .4 | 12.62 | +0.0280 | — 25.88 | —10.35 | —0.7280 | 269.36 | —0.091 |
| 6 | Madras | 1835 | | 11 | | +0.042 | .3 | 10.50 | +0.0126 | — 22.42 | — 6.73 | —0.2814 | 150.08 | —0.061 |
| 7 | Rümker | 1836 | | 6 | | —0.040 | .2 | 7.20 | —0.0080 | — 21.42 | — 4.28 | +0.1720 | 92.02 | +0.022 |
| 8 | Armagh | 1840 | 34.74 | 2 | | +0.006 | .1 | 3.47 | +0.0006 | — 22.68 | — 2.27 | —0.0138 | 52.21 | —0.025 |
| 9 | Gilliss | 1840 | 41.85 | 1 | +.011 | —0.010 | .05 | 2.09 | —0.0005 | — 15.57 | — 0.78 | +0.0080 | 12.48 | —0.005 |
| 10 | Edinburgh | 1842 | 42.18 | 5 | | +0.225 | .5 | 21.09 | +0.1125 | — 15.24 | — 7.62 | —1.7100 | 115.52 | —0.239 |
| 11 | Oeltzen's Arg'er | 1842 | 42.12 | 1 | | —0.118 | .05 | 2.11 | —0.0059 | — 15.30 | — 0.77 | +0.0944 | 12.24 | +0.104 |
| 12 | Greenwich | 1845 | 44.87 | 6 | +.011 | —0.186 | .7 | 31.41 | —0.1302 | — 12.55 | — 8.79 | +1.6368 | 110.88 | +0.173 |
| 13 | Radcliffe | 1845 | 47.9 | 7 | +.004 | +0.103 | .9 | 43.11 | +0.0927 | — 9.52 | — 8.57 | —0.8858 | 81.70 | —0.114 |
| 14 | Paris | 1845 | 41.6 | 18 | | —0.043 | 1.1 | 45.76 | —0.0473 | — 15.82 | —17.40 | +0.7482 | 274.92 | +0.028 |
| 15 | Poulkova | 1855 | 47.80 | 5 | +.0056 | —0.086 | 1.0 | 47.80 | —0.0860 | — 9.62 | — 9.62 | +0.8256 | 92.16 | +0.075 |
| 16 | Greenwich | 1860 | 59.5 | 3 | +.004 | —0.013 | .9 | 53.55 | —0.0117 | + 2.08 | + 1.87 | —0.0247 | 3.99 | +0.010 |
| 17 | Radcliffe | 1860 | 59.2 | 4 | +.004 | —0.003 | .4 | 23.68 | —0.0012 | + 1.78 | + 0.71 | —0.0021 | 1.26 | .000 |
| 18 | Yarnall | 1860 | 72.5 | 4 | | —0.112 | .7 | 50.75 | —0.0784 | + 15.08 | +10.56 | —1.1872 | 160.06 | +0.117 |
| 19 | Brussells | 1865 | 66.00 | 4 | | +0.032 | 1.1 | 72.60 | +0.0352 | + 8.58 | + 9.44 | +0.3008 | 80.84 | —0.031 |
| 20 | A. G. Zones | 1875 | 75.2 | 2 | | —0.131 | .3 | 22.56 | —0.0393 | + 17.78 | + 5.33 | —0.6943 | 94.84 | +0.138 |
| 21 | Paris | 1875 | 81.2 | 2 | | +0.039 | .3 | 24.36 | +0.0117 | + 23.78 | + 7.13 | +0.2769 | 168.98 | —0.028 |
| 22 | Stockholm | 1875 | 75.53 | 3 | | —0.130 | .4 | 30.21 | —0.0520 | + 18.11 | + 7.24 | —0.9360 | 130.32 | +0.137 |
| 23 | Madras | 1878.40 | 78.61 | 5 | | +0.098 | .5 | 39.31 | +0.0490 | + 21.19 | +10.60 | +1.0388 | 224.72 | —0.089 |
| 24 | Greenwich | 1880 | 84.24 | 7 | +.0056 | +0.045 | 2.9 | +244.30 | +0.1305 | + 26.82 | +77.78 | +3.5010 | 2085.04 | —0.032 |
| | | | | | | | 13.58 $\Sigma p$ | 779.71 $\Sigma pt$ | —0.0607 $\Sigma pn$ | | — 0.08 $\Sigma pT$ | +5.5322 $\Sigma pTn$ | +8481.37 $\Sigma pT^2$ | |

$$t_0 = \frac{779.71}{13.58} = 57.42$$

Weighed mean date = 1857.42

$$\Delta\alpha = \frac{-0.0607}{13.58} = -0.^s0045$$

$$\Delta\mu = \frac{5.5322}{8481.37} = +0.^s00065$$

$$\Delta\alpha_{1875} = -0.0045 + \big(0.00065 \times (1875 - 1857.42)\big) = +0.0069$$

| | | | |
|---|---|---|---|
| Assnmed $\alpha$ | $9^h$ | $7^m$ | $10^s.87$ |
| Final value | $9^h$ | $7^m$ | $10^s.877$ |
| Assumed $\mu$ | | | $+0.^s0056$ |
| Final value | | | $+0.^s00625$ |

| | |
|---|---|
| $\Sigma pv^2$ | 0.1277 |
| $\Sigma pn^2$ | 0.1315 |
| $-(\Sigma pn)\ \Delta\alpha$ | $-0.0003$ |
| $-(\Sigma pT^2)\ \Delta\mu$ | $-0.0036$ |
| Check | 0.1276 |

*Weights.*

In case of the Right Ascensions the weights have been taken from Auwers' values, *Astronomische Nachrichten*, Bd. 151, for all authorities found there. For other cases the attempt has been made to conform as closely to this system as practicable.

For the Declinations the system of weights is nearly the same as that given by Davis.* The most noticeable differences between the weights here employed and those of Newcomb are, first, the greater value assigned by Newcomb to the Poulkova and Washington catalogues; and second, in general the greater increase in weight corresponding to an increase in the number of observations. This last feature is not usually very conspicuous in the present discussion, as there are comparatively few cases where the number of observations is large. For the purpose of comparison the weights assigned by Newcomb to the authorities employed in the above example are given below, together with such as are given by Boss† in connection with his investigation.

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wght. here used | .6 | .3 | .0 | .6 | 1.0 | .5 | .5 | .3 | .5 | 3.0 | .0 | 3.0 | 2.0 | 2.0 | 2.0 | 1.0 | 1.5 | 2.0 | 1.0 | 1.0 | 1.0 | 1.5 | .3 | 1.5 | 2.0 | 1.0 | 3.0 |
| Newcomb | .5 | | | .4 | 1.0 | | | | | 3.0 | | 4.0 | | | 5.0 | 1.5 | 2.5 | | | | | | | | 2.5 | | 2.0 |
| Boss | | .1 | | .3 | .8 | .2 | | .6 | .3 | 1.5 | | 2.5 | .6 | 1.0 | 3.0 | 1.0 | .7 | 3.0 | 1.5 | | | | | | | | |

This comparison will illustrate the different conclusions which have been reached as to the relative merits of some of the authorities. It is not claimed that the weights here employed are in all cases the best, but the effort has been made to follow a consistent system throughout in order to reach results which shall be so far as possible homogeneous.

*The Star List.*

The list of 254 latitude stars which follows includes 74 which are found in Newcomb's new Fundamental Catalogue. The places of these have been taken directly from that publication, applying the reduction to Auwers' system as explained below. Polaris is an exception, the position being taken without change from Newcomb. There are also three stars given in Davis' paper before referred to.—*The Declinations and Proper Motions of Fifty-six Stars*—the declinations of these have been taken from that publication.

The coordinates of the remaining stars—180 right ascensions and 177 declinations—have been derived as explained in the preceding pages.

As Newcomb's system is no doubt preferable to that of Auwers' for the reason that

* *Declinations and Proper Motions of Fifty-six Stars*, pages 14–18.

† *Declinations of the Fixed Stars, Report of the U. S. Northern Boundary Commission*, Appendix ii.

it represents more closely the actual state of the celestial sphere, it is very desirable that we should be able to refer our coordinates to that system. This may be very readily done by employing the formulæ and tables given by Newcomb for passing from one system to the other. These are reproduced here for the convenience of any wishing to make the change. The reduction of the declinations to the system of Boss is also included.

In what follows N refers to the system of Newcomb,

A refers to that of Auwers.

On page 156 of Newcomb's memoir is given for the difference of the Equinoxes

$$N = A + {}^s.006 + {}^s.00100\,(T - 1875)$$

Combining this with the difference depending on the Declinations, page 165, the reduction in Right Ascension for any time $T$ has the form

$$N = A + \Delta a + \Delta\mu\,\frac{(T - 1875)}{100}$$

with a similar expression for the Declination.

In the table, divisions A and B give the data for reducing the Right Ascensions and Declinations respectively from the system of Auwers to that of Newcomb; C for reducing the declinations to the system of Boss.

| Declination. | A | | B | | C | |
|---|---|---|---|---|---|---|
| | $\Delta a$ | $\Delta\mu$ | $\Delta\delta$ | $\Delta\mu'$ | $\Delta\delta$ | $\Delta\mu'$ |
| | s | s | ″ | ″ | ″ | ″ |
| + 85° | | | − .00 | + .37 | − .04 | + .30 |
| 80 | − .017 | + .119 | + .03 | + .45 | − .07 | + .30 |
| 75 | − .008 | + .127 | + .04 | + .46 | − .10 | + .27 |
| 70 | − .000 | + .129 | + .02 | + .32 | − .13 | + .10 |
| 65 | + .004 | + .127 | + .03 | + .27 | − .14 | − .00 |
| 60 | + .005 | + .124 | + .09 | + .26 | − .10 | − .10 |
| 55 | + .005 | + .123 | + .19 | + .32 | − .04 | − .10 |
| 50 | + .002 | + .128 | + .22 | + .36 | + .04 | − .10 |
| 45 | − .014 | + .111 | + .30 | + .09 | + .07 | − .35 |
| 40 | − .012 | + .109 | + .32 | − .72 | + .08 | − 1.20 |
| 35 | − .009 | + .096 | + .29 | − .86 | + .06 | − 1.33 |
| 30 | − .004 | + .090 | + .26 | − .81 | + .05 | − 1.22 |
| 25 | + .004 | + .091 | + .24 | − .85 | + .06 | − 1.18 |
| 20 | + .006 | + .093 | + .24 | − .94 | + .09 | − 1.27 |
| 15 | + .009 | + .094 | + .31 | − 1.00 | + .15 | − 1.36 |
| 10 | + .011 | + .098 | + .36 | − .98 | + .18 | − 1.31 |
| + 5 | + .012 | + .103 | + .36 | − .92 | + .19 | − 1.24 |
| 0 | + .012 | + .108 | + .39 | − .80 | + .20 | − 1.16 |
| − 5 | + .012 | + .113 | + .42 | − .75 | + .23 | − 1.14 |
| − 10 | + .010 | + .113 | + .55 | − .80 | + .34 | − 1.25 |
| − 15 | + .010 | + .115 | + .74 | − .72 | + .48 | − 1.30 |
| − 20 | + .009 | + .116 | + .89 | − .54 | + .58 | − 1.30 |
| − 25 | + .009 | + .125 | + .99 | − .44 | + .66 | − 1.40 |

The reduction for proper motion is the second term in each of the above expressions. For example, for Declination 80°

$$\mu_N = \mu_A + .00119\ (T - 1875)$$

$$\mu'_N = \mu'_A + .0045\ \ (T - 1875)$$

$$\mu'_B = \mu'_A + .0030\ \ (T - 1875)$$

The results of a direct comparison of the stars common to the catalogues of Newcomb and Auwers will be found in No. 3742, *Astronomische Nachrichten*, in an article by Dr. Fritz Cohn entitled "Vergleichung des Newcomb'schen Fundamenentalcatalogs mit dem Auwers'schen A. G. C."

In the pages which follow the column headed *B. A. C.* gives the number corresponding to the star's place in the British Association Catalogue, with the exception of five not found in that publication. The magnitudes are from various sources and do not claim great precision. The column headed *A* gives the number of authorities employed in deducing the corresponding coordinate. Where N or D occurs in this column it implies that the corresponding coordinate is taken from Newcomb or Davis, as the case may be.

The differential coefficients include the proper motions $\mu$ and $\mu'$ in accordance with the formulæ given on page 9.

To illustrate the reduction to any epoch, let the Right Ascension and Declination of No. 3 be required for 1755:

$$1755 - 1875 = -120$$

Therefore

$$\alpha_{1755} = 0^h\ 10^m\ 33^s.963 - 120 \times 3^s.11489 + \tfrac{1}{2}\,(120)^2 \times 0^s.0002643 + 0^s.019 \times (-1.20)^3.$$

$$= 0^h\ 4^m\ 22^s.046$$

$$\delta_{1755} = 37^\circ\ 59'\ 14''.89 - 120 \times 20''.0272 + \tfrac{1}{2}\,(120)^2 \times (-0''.000295) - 0''.175 \times (-1.20)^3$$

$$= 37^\circ\ 19'\ 9''.80$$

Auwers' Bradley gives

$$\alpha = 0^h\ 4^m\ 22^s.08$$

$$\delta = 37^\circ\ 19'\ 10''.0$$

## *Definitive Positions 1875.0.*

| | B. A. C. | Mg. | $\alpha$ 1875.0 | $\frac{d\alpha}{dt}$ | $\frac{d^2\alpha}{dt^2}$ | $\frac{(100)^3}{6}\frac{d^3\alpha}{dt^3}$ | $\mu$ | $\delta$ 1875.0 | $\frac{d\delta}{dt}$ | $\frac{d^2\delta}{dt^2}$ | $\frac{(100)^3}{6}\frac{d^3\delta}{dt^3}$ | $\mu'$ | $\frac{A}{\alpha}$ | $\frac{A}{\delta}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | h m s | | | | | ° ′ ″ | | | | | | |
| 1 | 16 | 5.1 | 0 3 49.785 | + 3.09580 | +.0003283 | + .025 | +.00092 | 45 22 35.55 | +20.0460 | —.000162 | — .171 | —.0054 | | N |
| 2 | LL 220 | 7.5 | 10 12.247 | 3.12214 | 2468 | .017 | +.00069 | 35 47 41.51 | 20.0845 | 289 | .174 | +.0501 | 9 | 11 |
| 3 | 52 | 5. | 10 33.963 | 3.11489 | 2643 | .019 | —.00547 | 37 59 14.89 | 20.0272 | 295 | .175 | —.0057 | 23 | 26 |
| 4 | *60 | 6.2 | 12 7.151 | 3.13969 | 3169 | .023 | +.00133 | 43 5 48 13 | 20.0200 | 328 | .178 | —.0062 | 19 | 19 |
| 5 | 99 | 6.5 | 21 28.282 | 3.11329 | 1350 | .011 | —.00159 | 18 49 21.31 | 19.9573 | 510 | .173 | —.0090 | 16 | 18 |
| 6 | 126 | 4.2 | 0 25 54.538 | + 3 35929 | + 7016 | + .070 | +.00049 | 62 14 29.79 | +19.9212 | — 639 | — .217 | —.0050 | | N |
| 7 | 194 | 5.6 | 37 25.783 | 3.83965 | 16084 | .270 | —.00617 | 74 18 15.76 | 19.7567 | 994 | .319 | —.0307 | | N |
| 8 | 222 | 4.6 | 42 11.898 | 3.10632 | 785 | .009 | +.00444 | 6 54 15.47 | 19.6803 | 915 | .170 | —.0349 | | N |
| 9 | 259 | 3.9 | 49 49.230 | 3.30819 | 3068 | .018 | +.01211 | 37 49 14.99 | 19.6203 | 1129 | .204 | +.0380 | | N |
| 10 | 318 | 5.0 | 1 00 50.736 | 3.41633 | 3822 | .022 | +.01410 | 43 16 31.70 | 19.2915 | 1396 | .223 | —.0602 | 20 | 22 |
| 11 | 361 | 7. | 1 6 30.266 | + 3.01720 | + 186 | + .009 | —.00504 | — 7 26 49.97 | +19.1745 | — 1340 | — .153 | —.0413 | 15 | 16 |
| 12 | 394 | 6.7 | 12 45.553 | 3 93545 | 9621 | .085 | +.00744 | 64 0 6.49 | 19.0228 | 1877 | .331 | —.0293 | 17 | 18 |
| 13 | 360 | 2. | 12 59.80 | 20.8603 | 15057 | | +.1229 | 88 88 83.81 | 19.0457 | 9659 | | +.0051 | | N |
| 14 | 413 | 6.7 | 17 7.878 | 3.21167 | 1538 | .009 | +.00304 | 17 9 58.18 | 18.8985 | 1630 | .182 | —.0307 | 13 | 12 |
| 15 | 438 | 6.0 | 21 57.528 | 4.35677 | 14364 | .157 | +.02478 | 69 37 13.22 | 18.7107 | 2318 | .436 | —.0748 | | N |
| 16 | 459 | 7.0 | 1 25 55.826 | + 3.17059 | + 1217 | + .008 | +.00105 | 11 14 19.72 | +18.6672 | — 1774 | — .174 | +.0061 | 12 | 12 |
| 17 | 480 | 4.2 | 29 28.033 | 3.49478 | 3635 | .016 | —.01629 | 40 46 45.47 | 18.1746 | 2010 | .230 | —.3709 | | N |
| 18 | 502 | 4.9 | 33 12.472 | 3.51639 | 3603 | .016 | +.00127 | 39 56 35.06 | 18.3968 | 2109 | .233 | —.0217 | | N |
| 19 | 592 | 5.8 | 50 31.460 | 3.26527 | 1637 | .007 | +.00101 | 17 12 22.78 | 17.7500 | 2286 | .182 | —.0171 | 32 | 32 |
| 20 | 611 | 5.6 | 53 46.264 | 4.36499 | 10502 | .070 | —.00047 | 63 47 5.72 | 17.6345 | 3107 | .414 | +.0010 | | N |
| 21 | 656 | 3.1 | 2 2 6.635 | + 8.54883 | + 3043 | + .009 | +.01168 | 34 23 41.61 | +17.2389 | — 2712 | — .226 | —.0355 | | N |
| 22 | 706 | 6. | 11 13.393 | 3.83707 | 4751 | .014 | —.00658 | 46 48 6.64 | 16.8415 | 3099 | .277 | —.0143 | 18 | 21 |
| 23 | 744 | 4.6 | 18 47.640 | 4.84970 | 18108 | .077 | —.00157 | 66 50 19.89 | 16.4952 | 4096 | .518 | +.0074 | | N |
| 24 | 780 | 6.5 | 26 3.504 | 3.27527 | 1508 | .004 | —.00241 | 14 28 47.55 | 16.1580 | 2910 | .170 | +.0402 | 25 | 23 |
| 25 | 816 | 6.5 | 34 6.927 | 4.24693 | 6562 | .015 | +.00409 | 54 34 14.64 | 15.6597 | 3929 | .344 | —.0286 | 16 | 18 |
| 26 | 872 | 3.7 | 2 42 37.769 | + 3.51532 | + 2274 | + .002 | +.00414 | 26 44 37.80 | +15.1107 | — 3410 | — .197 | —.1028 | | N |
| 27 | 916 | 6.0 | 51 35.637 | 3.84960 | 3616 | .001 | —.00082 | 40 31 59.00 | 14.6504 | 3884 | .250 | —.0405 | 8 | 10 |
| 28 | 963 | V. | 3 0 2.496 | 3.87871 | 3554 | .000 | —.00031 | 40 28 20.47 | 14.1824 | 4061 | .244 | +.0045 | | N |
| 29 | 981 | 5.0 | 3 13.561 | 3.84883 | 3368 | — .001 | —.00340 | 39 8 6.03 | 13.9878 | 4081 | .234 | +.0083 | 20 | 22 |
| 30 | 993 | 6.0 | 6 39.454 | 3.95407 | 3713 | — .001 | +.00518 | 42 2 5.78 | 13.7791 | 4259 | .249 | +.0164 | 14 | 17 |
| 31 | 1050 | 6.5 | 3 17 24.064 | + 6.09182 | + 17880 | + .020 | +.00106 | 71 25 31.49 | +13.0686 | — 6798 | — .747 | +.0046 | 12 | 13 |
| 32 | 1068 | 3.8 | 20 23.777 | 3.24316 | 1167 | .000 | +.00305 | 9 17 43.01 | 12.8274 | 3687 | .136 | —.0366 | | N |
| 33 | 1119 | 6.4 | 82 21.681 | 3.38265 | 1421 | — .002 | +.00128 | 16 7 42.19 | 12 0132 | 3998 | .143 | —.0304 | 23 | 22 |
| 34 | 1144 | 4.6 | 38 5.857 | 5.41987 | 10153 | .026 | —.00185 | 65 8 12.27 | 11.6256 | 6485 | .493 | —.0130 | 18 | 18 |
| 35 | 1221 | 6.0 | 49 29.036 | 3.53321 | 1598 | .005 | +.00340 | 22 6 57.66 | 10.7081 | 4390 | .146 | —.1052 | 31 | 28 |
| 36 | 1237 | 4.9 | 3 54 2.951 | + 4.95181 | + 6417 | — .032 | —.00335 | 58 48 19.96 | +10.4740 | — 6199 | — .351 | —.0006 | 14 | 18 |
| 37 | 1274 | 5.8 | 4 1 53.137 | 3.48607 | 1379 | .006 | +.00697 | 19 16 36.53 | 9.8497 | 4475 | .129 | —.0342 | | N |
| 38 | 1286 | 5.6 | 5 53.405 | 5.23925 | 6978 | .048 | +.00063 | 61 31 58.83 | 9.5639 | 6755 | .371 | —.0136 | 13 | 16 |
| 39 | 1307 | 5.6 | 9 50.643 | 4.47574 | 3766 | .026 | +.00359 | 49 44 29.36 | 9.2099 | 5832 | .237 | —.0623 | 13 | 16 |
| 40 | 1364 | 6.5 | 18 9.030 | 3.80681 | 1792 | .012 | +.00483 | 31 9 16.66 | 8.5057 | 5056 | .142 | —.1161 | 17 | 17 |
| 41 | 1425 | 6.0 | 4 30 4.391 | + 4.70174 | + 3678 | — .039 | +.00035 | 52 49 39 86 | + 7.6519 | — 6369 | — .223 | —.0166 | 16 | 16 |
| 42 | 1444 | 5.9 | 33 30.448 | 3.74561 | 1457 | .012 | +.00218 | 28 22 14.07 | 7.3602 | 5113 | .117 | —.0298 | 19 | 18 |
| 43 | 1486 | 3.3 | 43 3.312 | 3.25165 | 722 | .005 | +.03020 | 6 44 27.92 | 6.6416 | 4548 | .072 | +.0345 | | N |
| 44 | 1496 | 6.0 | 46 30.153 | 7.52098 | 13291 | .292 | +.00303 | 74 4 17.30 | 6.3515 | 10441 | .606 | +.0298 | 11 | 16 |
| 45 | 1536 | 4.2 | 52 18.315 | 5.30905 | 4186 | .077 | —.00165 | 60 15 22.91 | 5.8237 | 7430 | .232 | —.0140 | | N |
| 46 | 1555 | 7.0 | 4 56 54.749 | + 3.56872 | + 921 | — .011 | +.00001 | 21 6 1.57 | + 5.4353 | — 5032 | — .076 | —.0156 | 16 | 16 |
| 47 | 1568 | 5.3 | 5 0 3.774 | 3.54044 | 836 | .010 | +.03669 | 18 28 30.56 | 5.2123 | 5062 | .070 | +.0272 | 38 | 88 |
| 48 | 1583 | 6.7 | 1 53.740 | 5.55689 | 4176 | .096 | —.00509 | 62 32 1.37 | 5.0380 | 7859 | .224 | +.0079 | 13 | 16 |
| 49 | 1598 | 6.8 | 6 30.813 | 9.34113 | 17142 | .728 | —.00238 | 78 16 57.33 | 4.6398 | 13270 | .743 | +.0019 | 12 | 12 |
| 50 | *1611 | 5.0 | 5 6 45.382 | 3.13271 | 513 | .005 | —.00113 | 2 42 37.77 | 4.6206 | 4464 | .046 | +.0034 | 20 | 19 |
| 51 | *1625 | 7.0 | 5 9 25.519 | + 3.50302 | + 725 | — .010 | —.00060 | 18 17 52.85 | + 4.3856 | — 5003 | — .058 | —.0040 | 9 | 11 |
| 52 | 1687 | 1.7 | 18 25.625 | 3.21446 | 478 | .006 | —.00144 | 6 14 4.10 | 3.6099 | 4625 | .038 | —.0079 | | N |
| 53 | 1662 | 6.4 | 22 8.816 | 18.55094 | 63412 | 8.022 | +.01181 | 85 7 35.66 | 3.2903 | 26717 | 2.483 | —.0069 | | N |
| 54 | 1706 | 6.3 | 23 1.262 | 7.98044 | 7698 | .436 | —.00156 | 74 57 22.57 | 3.2342 | 11499 | .349 | +.0124 | | N |
| 55 | 1751 | 5.5 | 29 55.061 | 5.99596 | 2712 | .144 | —.00177 | 65 37 34.15 | 2.5911 | 8678 | .136 | —.0337 | 14 | 17 |

* Maj.

| | B. A. C. | Mg. | $\alpha$ 1875.0 | $\frac{d\alpha}{dt}$ | $\frac{d^2\alpha}{dt^2}$ | $\frac{(100)^3}{6}\frac{d^3\alpha}{dt^3}$ | $\mu$ | $\delta$ 1875.0 | $\frac{d\delta}{dt}$ | $\frac{d^2\delta}{dt^2}$ | $\frac{(100)^3}{6}\frac{d^3\delta}{dt^3}$ | $\mu'$ | $\frac{A}{\alpha}$ | $\frac{A}{\delta}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | h m s | | | | | ° ′ ″ | | | | | | |
| 56 | 1789 | 6.0 | 5 33 17.560 | + 2.98760 | +.0000324 | — .004 | —.00026 | — 3 38 10.93 | + 2.3379 | —.004337 | — .020 | +.0062 | 15 | 14 |
| 57 | 1813 | 6.3 | 39 29.025 | 6.43751 | 2256 | .195 | —.00332 | 68 25 52.32 | 1.7300 | 9354 | .107 | —.0629 | 11 | 15 |
| 58 | 1821 | 6.0 | 39 34.191 | 3.44764 | 383 | .010 | —.00070 | 15 46 17.27 | 1.7864 | 5015 | .021 | +.0011 | 22 | 21 |
| 59 | 1846 | 5.3 | 42 31.641 | 3.36855 | 333 | .009 | — 00190 | 12 36 34.46 | 1.5116 | 4902 | .016 | —.0158 | 16 | 16 |
| 60 | 1862 | 6.0 | 45 16.259 | 3.40621 | 318 | .009 | —.00210 | 14 8 16.31 | 1.2898 | 4960 | .014 | +.0018 | 23 | 23 |
| 61 | 1874 | 7.0 | 5 47 50.816 | + 6.21420 | + 1221 | — .171 | —.00295 | 66 59 52.43 | + 1.0172 | — 9050 | — .053 | —.0457 | 11 | 16 |
| 62 | 1923 | 6.0 | 54 17.298 | 4.32443 | 258 | .033 | +.00965 | 42 54 45.79 | 0.3511 | 6321 | — .006 | —.1487 | 23 | 23 |
| 63 | 1942 | 6.0 | 57 58.099 | 4.13501 | 182 | .027 | —.00032 | 38 29 28.93 | + 0.1357 | 6031 | + .002 | —.0420 | 16 | 15 |
| 64 | 1970 | 6.5 | 6 2 0.277 | 3.61559 | + 141 | .013 | —.00245 | 22 12 28.27 | — 0.1745 | 5268 | .006 | +.0008 | 20 | 19 |
| 65 | 2007 | 4.3 | 8 35.616 | 5.30028 | — 399 | .086 | —.00012 | 59 3 10.51 | 0.7247 | 7721 | .039 | +.0271 | | N |
| 66 | 2045 | 5.5 | 6 15 54.004 | + 5.24501 | — 812 | — .082 | —.00218 | 58 28 56.15 | — 1.3973 | — 7622 | + .064 | —.0072 | 18 | 18 |
| 67 | 2083 | 6.2 | 22 7.380 | 7.61230 | 4089 | .378 | — 03654 | 73 47 14.26 | .1.9664 | 10989 | .214 | —.0337 | 10 | 11 |
| 68 | 2101 | 7.5 | 22 48.877 | 3.62401 | 130 | .013 | —.00270 | 22 37 32.72 | 1.9910 | 5247 | .034 | +.0021 | 12 | 13 |
| 69 | 2126 | 4.4 | 26 8.672 | 3.24526 | 15 | .007 | —.00003 | 7 25 21.07 | 2.2870 | 4692 | .028 | —.0042 | | N |
| 70 | 2139 | 6.7 | 27 57.173 | 4.12875 | 506 | .025 | —.00071 | 38 32 37.82 | 2.4613 | 5965 | .057 | —.0215 | 13 | 13 |
| 71 | 2159 | 5.1 | 6 30 24.188 | + 4.28990 | — 698 | — .031 | —.00077 | 42 35 46.54 | — 2.7119 | — 6189 | + .069 | —.0594 | 16 | 19 |
| 72 | *2187 | 5.1 | 35 11.272 | 5.31695 | 2019 | .084 | —.00411 | 59 33 53.72 | 3.0706 | 7644 | .135 | —.0037 | 19 | 21 |
| 73 | 2233 | 6.0 | 44 3.520 | 3.59865 | 389 | .012 | —.00132 | 21 54 23.21 | 3.8614 | 5133 | .060 | —.0298 | 23 | 21 |
| 74 | 2301 | 6.5 | 55 33.689 | 3.81888 | 884 | .015 | +.01101 | 29 32 40.18 | 5 6255 | 5402 | .091 | —.8112 | 21 | 18 |
| 75 | 2317 | 6.3 | 7 1 33.458 | 11.67981 | 35652 | 1.495 | +.00525 | 81 28 40.56 | 5.3582 | 16407 | 1.498 | —.0362 | 15 | 19 |
| 76 | 2341 | 5.6 | 7 3 38.299 | + 4.69611 | — 2349 | — .044 | —.00027 | 51 37 59.68 | — 5.4925 | — 6562 | + .171 | +.0048 | 13 | 14 |
| 77 | 2358 | 4.1 | 5 28.829 | 3.06513 | 155 | .004 | —.00067 | — 0 17 15.48 | 5.6309 | 4264 | .057 | +.0212 | | N |
| 78 | 2365 | 7.7 | 7 48.006 | 5.20696 | 3758 | .068 | —.00529 | 59 8 14.81 | 5.8709 | 7231 | .237 | —.0243 | 13 | 14 |
| 79 | 2410 | 3.6 | 12 39.388 | 3.58903 | 726 | .010 | —.00189 | 22 12 37.58 | 6.2573 | 4944 | .095 | —.0056 | | N |
| 80 | 2439 | 5.8 | 17 51.282 | 6.30888 | 8341 | .142 | +.00058 | 68 43 2.93 | 6.7301 | 8647 | .438 | —.0479 | | N |
| 81 | 2473 | 4.8 | 7 22 50.261 | + 3.34290 | — 523 | — .006 | —.00117 | 12 15 47.15 | — 7.1017 | — 4528 | + .088 | —.0099 | | N |
| 82 | 2488 | 5.8 | 27 26.887 | 4.37485 | 2480 | .027 | —.00280 | 46 27 12.20 | 7.4767 | 5886 | .191 | —.0091 | 11 | 11 |
| 83 | 2509 | 4.9 | 31 0.239 | 3.92828 | 1587 | .015 | —.00307 | 34 52 7.63 | 7.8851 | 5246 | .149 | —.1296 | | N |
| 84 | 2551 | 3.7 | 36 53.968 | 3.63058 | 1096 | .009 | —.00233 | 24 41 44.71 | 8.2801 | 4790 | .127 | —.0515 | | N |
| 85 | 2616 | 7.0 | 46 18.214 | 4.90192 | 4898 | .039 | +.00035 | 56 49 49.34 | 8.9950 | 6355 | .305 | —.0231 | 14 | 17 |
| 86 | 2585 | 6.6 | 7 46 43.781 | +15.27834 | — 123878 | —1.757 | —.00257 | 84 24 41.75 | — 9.0370 | — 19867 | +4 573 | —.0318 | 23 | 18 |
| 87 | 2660 | 5.4 | 53 29.442 | 2.99857 | 271 | .001 | —.00501 | — 3 20 25.95 | 9.5220 | 3800 | .087 | +.0079 | 21 | 21 |
| 88 | 2676 | 6.3 | 56 27.588 | 3.54958 | 1169 | .006 | —.00455 | 22 25 9.48 | 9.7558 | 4475 | .140 | +.0018 | 16 | 16 |
| 89 | 2704 | 6.0 | 59 47.628 | 4.96971 | 5950 | .034 | — 00122 | 58 36 41.87 | 10.0901 | 6235 | .352 | —.0786 | 12 | 13 |
| 90 | 2786 | 5.2 | 8 12 28.130 | 3.65640 | 1661 | .006 | —.00176 | 27 37 14.44 | 11.3336 | 4417 | .169 | —.3769 | | N |
| 91 | 2792 | 5. | 8 14 19.908 | + 4.58132 | — 4951 | — .018 | —.00274 | 53 37 12.17 | —11.1928 | — 5515 | + .314 | —.0999 | 17 | 18 |
| 92 | 2819 | 3.5 | 19 51.800 | 5.04253 | 7647 | .021 | —.01719 | 61 8 1.23 | 11.6083 | 5957 | .418 | —.1155 | | N |
| 93 | 2880 | 6.5 | 28 8.194 | 3.45679 | 1271 | .002 | —.00429 | 20 1 5.96 | 12.0785 | 3967 | .158 | .0000 | 21 | 21 |
| 94 | 2953 | 4.2 | 37 34.766 | 3.41847 | 1271 | .001 | —.00172 | 18 36 44.03 | 12.9579 | 3796 | .160 | —.2303 | | N |
| 95 | 2982 | 5.5 | 43 3.436 | 5.00819 | 8968 | .001 | —.00328 | 62 25 39.75 | 13.0708 | 5472 | .463 | +.0237 | 27 | 24 |
| 96 | 3003 | 6.0 | 8 45 53.055 | + 5.22336 | — 10816 | + .007 | —.00501 | 65 4 47.54 | —13.3693 | — 5645 | + .524 | —.0886 | 24 | 23 |
| 97 | 3052 | 6.0 | 50 36.236 | 3.35833 | 1157 | .000 | +.00301 | 16 3 35.26 | 13.5503 | 3547 | .161 | +.0371 | 26 | 23 |
| 98 | 3083 | 6.7 | 56 30.430 | 4.25797 | 5131 | .001 | —.01300 | 51 19 12.87 | 14.0420 | 4384 | .319 | —.0793 | 13 | 13 |
| 99 | 3109 | 6.0 | 9 0 29.562 | 3.61621 | 2148 | .001 | —.00407 | 30 9 19.01 | 14.2047 | 3656 | .206 | +.0062 | 17 | 17 |
| 100 | 3140 | 5.0 | 7 10.877 | 4.36340 | 6123 | .008 | +.00625 | 54 32 11.05 | 14.5532 | 4300 | .354 | +.0646 | 24 | 25 |
| 101 | 3170 | 6.5 | 9 11 56.642 | + 3.52033 | — 1924 | + .002 | —.00348 | 26 46 37.94 | —14.9166 | — 3369 | + .199 | —.0167 | 9 | 11 |
| 102 | 3228 | 6.0 | 21 49.756 | 3.20010 | 838 | .003 | —.00289 | 8 43 56.79 | 15.4741 | 2902 | .157 | —.0093 | 13 | 14 |
| 103 | 3231 | 6.0 | 23 3.368 | 5.81249 | 21387 | .152 | +.01541 | 72 45 30.61 | 15.6072 | 5309 | .799 | —.0743 | 14 | 17 |
| 104 | 3281 | 6.0 | 30 33.134 | 3.76960 | 3445 | .007 | —.00295 | 40 47 59.00 | 15.9282 | 3265 | .255 | +.0113 | 19 | 21 |
| 105 | 3307 | 6.0 | 34 15.307 | 3.73939 | 3391 | .008 | —.00089 | 40 19 34.69 | 16.1742 | 3164 | .252 | —.0402 | 15 | 17 |
| 106 | 3375 | 7.0 | 9 46 9.550 | + 3.59771 | — 2823 | + .009 | —.00171 | 35 34 15.89 | —16.7336 | — 2820 | + .233 | —.0030 | 15 | 14 |
| 107 | 3397 | 6.0 | 50 3.213 | 3.81469 | 4309 | .015 | —.00137 | 46 0 31.54 | 16.9601 | 2914 | .278 | —.0440 | 9 | 12 |
| 108 | 3468 | 6.0 | 10 3 48.030 | 3.57424 | 3096 | .013 | —.00551 | 38 1 0.17 | 17.5653 | 2452 | .237 | —.0340 | 11 | 12 |
| 109 | 3505 | 3.6 | 9 33.103 | 3.64573 | 3827 | .017 | —.01532 | 43 32 15.51 | 17.8074 | 2378 | .254 | —.0372 | | N |
| 110 | 3495 | 5.6 | 11 9.018 | 9.80634 | 160804 | 6.885 | —.09600 | 84 53 5.94 | 17.8886 | 6400 | 3.294 | —.0540 | | N |

* Mean A.B.

| | B. A. C. | Mg. | $\alpha$ 1875.0 | $\frac{d\alpha}{dt}$ | $\frac{d^2\alpha}{dt^2}$ | $\frac{(100)^3}{6}\frac{d^3\alpha}{dt^3}$ | $\mu$ | $\delta$ 1875.0 | $\frac{d\delta}{dt}$ | $\frac{d^2\delta}{dt^2}$ | $\frac{(100)^3}{6}\frac{d^3\delta}{dt^3}$ | $\mu'$ | $\frac{A}{\alpha}$ | $\frac{A}{\delta}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | h m s | | | | | ° ′ ″ | | | | | | |
| 111 | 3530 | 6.0 | 10 14 44.321 | + 3.59054 | —.0003573 | + .016 | —.01279 | 41 51 47.04 | —18.1164 | —.002235 | + .246 | —.1404 | 21 | 21 |
| 112 | 3551 | 6.1 | 17 7.409 | 3.03233 | 159 | .007 | —.00501 | — 3 26 35.23 | 18.0605 | 1838 | .151 | +.0070 | 20 | 18 |
| 113 | 3584 | 6.0 | 22 48.377 | 3.52476 | 3229 | .015 | —.00202 | 39 33 50.76 | 18.2753 | 2035 | .235 | +.0024 | 16 | 19 |
| 114 | 3647 | 5.0 | 33 23.690 | 4.17155 | 11213 | .103 | —.02817 | 66 22 13.50 | 18.7145 | 2150 | .388 | —.0752 | 23 | 25 |
| 115 | 3693 | 5.8 | 39 47.972 | 3.18389 | 1035 | .009 | —.00992 | 14 51 14.67 | 18.8904 | 1506 | .179 | —.0516 | 39 | 36 |
| 116 | 3725 | 5.1 | 10 45 59.573 | + 3.67412 | — 5908 | + .042 | —.00967 | 55 14 56.39 | —19.0313 | — 1614 | + .274 | —.0136 | 21 | 23 |
| 117 | 3751 | 7.0 | 49 47.288 | 3.26704 | 1770 | .012 | —.00332 | 26 10 1.59 | 19.1295 | 1353 | .195 | —.0090 | 15 | 15 |
| 118 | 3787 | 7.8 | 58 35.045 | 3.21245 | 1677 | .012 | —.03152 | 25 52 40.14 | 19.3981 | 1146 | .186 | —.0596 | 17 | 18 |
| 119 | 3825 | 6.7 | 11 5 27.361 | 3.52927 | 5624 | .045 | —.00283 | 55 34 23.41 | 19.4987 | 1129 | .248 | —.0097 | 11 | 14 |
| 120 | 3877 | 4.0 | 17 24.428 | 3.13061 | 654 | .010 | +.00937 | 11 13 3.04 | 19.7823 | 761 | .175 | —.0734 | | N |
| 121 | 3914 | 4.1 | 11 23 57.710 | + 3.63952 | — 11151 | + .154 | —.00860 | 70 1 14.71 | —19.8307 | — 744 | + .274 | —.0239 | | N |
| 122 | 3949 | 6.0 | 31 6.713 | 3.27501 | 4171 | .035 | —.00710 | 51 18 38.87 | 19.9299 | 514 | .202 | —.0348 | 11 | 13 |
| 123 | LL. 22186 | 7.5 | 37 35.183 | 3.14463 | 1757 | .015 | —.00382 | 30 16 25.28 | 19.9408 | 361 | .179 | +.0176 | 5 | 5 |
| 124 | 4010 | 6.4 | 45 46.132 | 3.47944 | 3134 | .032 | +.34093 | 38 36 55.24 | 25.7877 | 321 | .240 | —5.7721 | | N |
| 125 | W.B. 956 | 7.0 | 49 54.785 | 3.12117 | — 2712 | .023 | —.00537 | 42 42 33.60 | 20.0439 | — 114 | .176 | —.0091 | 7 | 8 |
| 126 | 4063 | 7.0 | 11 57 11.829 | + 3.06441 | + 422 | + .010 | —.00647 | — 4 46 59.70 | —20.0549 | + 32 | + .166 | —.0022 | 20 | 16 |
| 127 | 4070 | 5.7 | 58 25.584 | 3.15165 | — 48131 | 3.874 | —.06178 | 86 16 47.85 | 19.9778 | 55 | .191 | +.0760 | 29 | 26 |
| 128 | 4074 | 6.0 | 59 20.134 | 3.07126 | 5797 | .069 | —.00830 | 63 37 53.58 | 20.1359 | 73 | .168 | —.0818 | 19 | 19 |
| 129 | 4099 | 6.5 | 12 4 9.300 | 3.06241 | 722 | .011 | —.00219 | 17 30 17.81 | 20.0439 | 167 | .165 | +.0070 | 18 | 18 |
| 130 | 4123 | 3.4 | 9 13.914 | 3.00081 | 4260 | .044 | +.01382 | 57 43 38.27 | 20.0356 | 263 | .156 | +.0024 | | N |
| 131 | 4141 | 6. | 12 13 0.273 | + 3.03607 | — 1015 | + .013 | —.00284 | 23 43 45.16 | —20.0327 | + 337 | + .161 | —.0108 | 20 | 19 |
| 132 | 4195 | 4.6 | 20 42.369 | 2.99891 | 1257 | .014 | —.00657 | 28 57 48.51 | 20.0527 | 480 | .155 | —.0803 | | N |
| 133 | 4217 | 6.0 | 24 7.806 | 2.85950 | 2969 | .030 | —.03144 | 52 13 32.78 | 19.9400 | 519 | .135 | +.0032 | 21 | 20 |
| 134 | 4239 | 3.9 | 28 8.244 | 2.59786 | 5412 | .087 | —.01261 | 70 28 39 03 | 19.8964 | 547 | .101 | +.0069 | | N |
| 135 | 4271 | 5.1 | 35 33.461 | 3.03725 | 165 | .010 | +.00488 | 10 55 29.28 | 19.9102 | 771 | .160 | —.0969 | | N |
| 136 | 4300 | 6. | 12 41 58.304 | + 2.58448 | — 3569 | + .046 | —.00020 | 63 27 49.45 | —19.7291 | + 771 | + .100 | —.0102 | 18 | 14 |
| 137 | 4318 | 7. | 45 59.257 | 2.98460 | 436 | .011 | —.00232 | 17 45 15.18 | 19.6561 | 952 | .151 | —.0043 | 15 | 14 |
| 138 | 4371 | 6. | 56 53.585 | 2.36184 | 2704 | .038 | —.02840 | 64 16 55.50 | 19.4285 | 920 | .077 | +.0109 | 15 | D |
| 139 | 4403 | 6.7 | 13 3 39.125 | 2.95067 | 297 | .010 | —.00589 | 17 30 56.71 | 19.2846 | 1261 | .145 | +.0011 | 10 | D |
| 140 | 4433 | 5.5 | 8 2.768 | 2.72915 | 1348 | .016 | —.00529 | 40 48 54.77 | 19.1675 | 1245 | .114 | +.0093 | 19 | 15 |
| 141 | 4467 | 5.7 | 13 14 42.758 | + 2.69642 | — 1244 | + .015 | —.00615 | 40 48 26.06 | —19.0115 | + 1338 | + 110 | —.0135 | | N |
| 142 | 4510 | 5.4 | 23 51.663 | 2.21159 | 1520 | .021 | —.01198 | 60 35 30.75 | 18.7026 | 1228 | .066 | +.0240 | | N |
| 143 | *4563 | 5.8 | 34 42.246 | 2.86584 | — 215 | .009 | —.00473 | 20 35 19.01 | 18.8386 | 1755 | .128 | +.0277 | 28 | 23 |
| 144 | 4604 | 7.0 | 42 11.369 | + 3.00164 | + 800 | + .007 | —.00292 | — 2 12 59.63 | 18.0891 | + 2021 | .158 | +.0044 | 12 | 14 |
| 145 | 4643 | 6.3 | 45 59.908 | — 2.04548 | + 54886 | —2.010 | +.02175 | 83 22 45.61 | 18.0066 | — 1240 | .668 | —.0593 | 19 | 23 |
| 146 | 4694 | 7.2 | 14 0 53.630 | + 2.66069 | — 374 | + .009 | +.00002 | 31 26 53.82 | —17.4277 | + 2028 | + .101 | —.0994 | 17 | 14 |
| 147 | 4701 | 6.0 | 3 37.069 | 2.24714 | 626 | .010 | —.00533 | 50 2 58.10 | 17.1566 | 1753 | .066 | +.0504 | 21 | 21 |
| 148 | 4728 | 6.0 | 9 21.039 | 2.42131 | 496 | .009 | —.00461 | 42 6 22.85 | 17.0451 | 1958 | .079 | —.1011 | 14 | 12 |
| 149 | 4758 | 6.0 | 14 39.780 | 2.46386 | 416 | .009 | —.00028 | 39 22 9.29 | 16.6933 | 2063 | .081 | —.0024 | 17 | 17 |
| 150 | 4825 | 6.2 | 29 31.903 | 2.45312 | 224 | .007 | —.00354 | 37 10 33.39 | 15.9886 | 2238 | 078 | —.0586 | 17 | 17 |
| 151 | 4841 | 6.0 | 14 33 30.806 | + 2.25487 | — 212 | + .007 | —.01069 | 44 10 55.50 | —15.6918 | + 2100 | + .064 | +.0293 | 16 | 19 |
| 152 | 4874 | 6.2 | 38 56.377 | 1.48735 | + 1046 | — .005 | +.00866 | 61 47 42.71 | 15.4542 | 1461 | .045 | —.0323 | 16 | 19 |
| 153 | 4905 | 4.6 | 45 37.472 | 2.76605 | 217 | + .005 | +.00903 | 19 37 14.04 | 15.1218 | 2741 | .102 | —.0803 | | N |
| 154 | 4926 | 5.7 | 50 19.265 | 2.82767 | 354 | + .004 | —.00299 | 14 57 9.49 | 14.7674 | 2851 | .106 | —.0009 | | N |
| 155 | 4949 | 4.9 | 55 36.075 | 0.93382 | 2856 | — .021 | —.01339 | 66 25 50.42 | 14.4330 | 993 | .058 | +.0170 | | N |
| 156 | 4974 | 4.9 | 14 59 40.343 | + 1.97993 | + 195 | + .003 | —.03865 | 48 8 30.82 | —14.1646 | + 2060 | + .049 | +.0361 | | N |
| 157 | 5000 | 7.2 | 15 5 35.112 | 2.42969 | 72 | .004 | —.00047 | 33 33 11.89 | 13.8331 | 2625 | .070 | —.0023 | 11 | 10 |
| 158 | 5072 | 5.3 | 16 48.324 | 2.40058 | 136 | .004 | —.00477 | 33 22 55.55 | 13 0931 | 2701 | .065 | +.0104 | 16 | 21 |
| 159 | 5113 | 6.7 | 25 24.620 | 1.90462 | 376 | + .001 | —.00212 | 48 8 35.78 | 12.5294 | 2221 | .044 | —.0050 | 15 | 14 |
| 160 | 5147 | 5.9 | 25 10.716 | 0.82293 | 2658 | — .018 | —.01874 | 64 37 46.26 | 12.1847 | 981 | .057 | +.0806 | 15 | 20 |
| 161 | 5190 | 5.8 | 15 35 14.345 | + 2.75440 | + 412 | + .002 | +.00032 | 16 25 44.63 | —11.8507 | + 3293 | + .082 | —.0093 | 21 | 20 |
| 162 | 5210 | 6.5 | 39 26.853 | 1.02603 | 721 | — .002 | —.00812 | 52 45 22.11 | 11.5070 | 1979 | .038 | +.0352 | 15 | 15 |
| 163 | 5236 | 6.0 | 43 25.472 | 2.46853 | 265 | + .002 | —.00190 | 28 32 28.75 | 11.2549 | 3026 | .062 | +.0011 | 16 | 19 |
| 164 | 5271 | 4.6 | 48 21.287 | 2.07185 | 178 | + .001 | +.03903 | 42 48 8.18 | 10.2675 | 2631 | .042 | +.6288 | | N |
| 165 | 5295 | 5.5 | 51 14.803 | + 2.18162 | 271 | + .001 | +.00323 | 38 18 32.54 | 10.5978 | + 2743 | .046 | +.0844 | 19 | 20 |

* Maj.

| | B. A. C. | Mg. | $\alpha$ 1875.0 | $\frac{da}{dt}$ | $\frac{d^2a}{dt^2}$ | $\frac{(100)^3}{6}\frac{d^3a}{dt^3}$ | $\mu$ | $\delta$ 1875.0 | $\frac{d\delta}{dt}$ | $\frac{d^2\delta}{dt^2}$ | $\frac{(100)^3}{6}\frac{d^3\delta}{dt^3}$ | $\mu'$ | $\frac{A}{\alpha}$ | $\frac{A}{\delta}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | h m s | | | | | ° ′ ″ | | | | | | |
| 166 | B.D.72.703 | 7.0 | 15 56 54.384 | — 0.63714 | +.0007861 | — .054 | —.01014 | 72 44 57.06 | —10.2427 | —.000767 | + .168 | +.0179 | 6 | 7 |
| 167 | 5325 | 6.4 | 57 34.955 | + 2.96095 | 631 | .001 | —.00389 | 5 19 56.97 | 10.1956 | + 3756 | .086 | +.0169 | 19 | 16 |
| 168 | 5343 | 6.5 | 58 1.161 | — 1.51902 | 13021 | .090 | +.00588 | 75 55 54.43 | 10.1955 | — 1858 | .297 | —.0187 | 15 | 16 |
| 169 | 5366 | 6.0 | 16 2 26.482 | + 2.88865 | 553 | .000 | —.00184 | 8 52 4.99 | 9.8430 | + 3711 | .079 | —.0015 | 18 | 17 |
| 170 | 5405 | 6.0 | 7 4.377 | + 2.96279 | 614 | .001 | +.00069 | 5 20 31.84 | 9.4868 | + 3849 | .081 | —.0003 | 18 | 16 |
| 171 | 5462 | 5.5 | 16 14 24.859 | — 1.80071 | + 12648 | — .059 | —.00052 | 76 11 29.11 | — 8.9127 | — 2293 | + .304 | +.0030 | | N |
| 172 | 5466 | 3.8 | 16 24.391 | + 2.64326 | 381 | .000 | —.00432 | 19 26 52.79 | 8.7129 | + 3500 | .057 | +.0463 | | N |
| 173 | 5512 | 2.9 | 22 18.101 | 0.79905 | 1853 | .010 | —.00317 | 61 47 51.17 | 8.2369 | 1093 | .044 | +.0554 | | N |
| 174 | 5568 | 6.0 | 32 32.500 | 1.74510 | 533 | .002 | —.00274 | 46 52 1.83 | 7.4603 | 2390 | .029 | +.0082 | 14 | 15 |
| 175 | 5619 | 5.8 | 39 15.046 | 2.21116 | 327 | .000 | —.00606 | 34 16 13.25 | 6.8496 | 3048 | .033 | +.0709 | 14 | 15 |
| 176 | 5658 | 6.0 | 16 44 17.644 | + 1.22618 | + 957 | — .005 | +.00315 | 55 37 55.19 | — 6.5113 | + 1724 | + .028 | —.0066 | 13 | 16 |
| 177 | 5703 | 6.3 | 49 55.234 | 2.45154 | 331 | .001 | —.00071 | 25 56 0.35 | 6.0480 | 3434 | .035 | — 0109 | 16 | 18 |
| 178 | 5752 | 5.5 | 57 4.066 | + 1.09339 | 959 | — .005 | —.00688 | 56 52 21.34 | 5.4073 | + 1549 | .026 | +.0306 | 20 | 16 |
| 179 | 5780 | 4.4 | 58 50.852 | — 6.38651 | 30769 | + .560 | +.00448 | 82 14 22.61 | 5.2927 | — 8955 | .924 | —.0050 | | N |
| 180 | 5774 | 5.9 | 17 1 46.818 | + 3.09194 | 521 | — .004 | —.00092 | — 0 54 46.32 | 5.0679 | + 4385 | .048 | —.0281 | 22 | 21 |
| 181 | 5786 | 7.0 | 17 3 23.583 | + 2.47551 | + 325 | — .001 | —.00182 | 24 39 2.72 | — 4.9452 | + 3519 | + .029 | —.0421 | 13 | 16 |
| 182 | 5801 | 6. | 5 23.866 | 1.14958 | 819 | .004 | —.00199 | 55 55 38.88 | 4.6969 | 1647 | .022 | +.0358 | 10 | 10 |
| 183 | 5828 | 3.2 | 9 53.866 | 2.46114 | 333 | .001 | —.00285 | 24 59 16.53 | 4.4983 | 3519 | .026 | —.1496 | | N |
| 184 | 5842 | 4.8 | 12 42.531 | 2.21177 | 311 | .001 | —.00299 | 33 14 9.32 | 4.1053 | 3171 | .020 | +.0035 | | N |
| 185 | 5911 | 5.7 | 23 25.523 | 1.58640 | 445 | — .003 | —.00092 | 48 21 56.97 | 3.2017 | 2297 | .014 | —.0149 | | N |
| 186 | 5941 | 2.3 | 17 29 7.956 | + 2.78178 | + 333 | — .002 | +.00695 | 12 39 9.19 | — 2.9184 | + 4042 | + .021 | —.2256 | | N |
| 187 | 6006 | 4.9 | 37 41.102 | — 0.36028 | 1077 | + .004 | +.00077 | 68 48 55.94 | 1.6344 | — 513 | .027 | +.3151 | | N |
| 188 | 6122 | 5.8 | 57 21.255 | — 1.04540 | 571 | + .021 | +.00081 | 72 0 59.20 | — 0.2393 | — 1522 | + .016 | —.0078 | 19 | 21 |
| 189 | 6143 | 3.7 | 18 1 25.433 | + 2.84192 | 181 | — .003 | —.00546 | 9 32 51.52 | + 0.2215 | + 4136 | — .002 | +.0969 | | N |
| 190 | 6193 | 6. | 8 54.682 | 1.99699 | 213 | — .001 | —.00345 | 38 44 22.70 | 0.7839 | 2902 | .002 | +.0043 | 15 | 13 |
| 191 | 6203 | 5.3 | 18 11 45.540 | + 1.86336 | + 204 | — .002 | —.00170 | 42 7 3.70 | + 1.0309 | + 2707 | — .002 | +.0024 | | N |
| 192 | 6232 | 6.5 | 15 2.707 | 2.31200 | 192 | .001 | —.00198 | 29 36 47.62 | 1.3258 | 3356 | .006 | +.0102 | 12 | 14 |
| 193 | 6246 | 6.3 | 17 0.418 | 1.40442 | 159 | .003 | —.00402 | 51 17 36.32 | 1.4358 | 2030 | .002 | — 0510 | 14 | D |
| 194 | 6258 | 6.0 | 18 33.020 | 1.40906 | 136 | .003 | —.00336 | 51 14 28.25 | 1.6091 | 2036 | .002 | —.0122 | 10 | 15 |
| 195 | 6300 | 5.7 | 24 24.823 | 2.48523 | + 162 | .001 | —.00113 | 23 47 3.76 | 2.1449 | 3593 | .013 | +.0137 | 19 | 19 |
| 196 | 6348 | 5.5 | 18 30 25.204 | + 1.03378 | — 86 | — .004 | —.00171 | 56 57 1.74 | + 2.6403 | + 1481 | — .007 | —.0137 | 19 | 10 |
| 197 | 6373 | 6.5 | 36 53.277 | 0.72915 | — 385 | .004 | —.00151 | 60 35 43.03 | 3.2589 | 1034 | .012 | +.0451 | 10 | 8 |
| 198 | 6387 | 4.3 | 40 16.953 | 2.57899 | + 168 | .001 | —.00297 | 20 25 41.21 | 3.1726 | 3684 | .022 | —.3341 | | N |
| 199 | 6476 | 6.0 | 51 29.318 | 1.58105 | + 29 | .002 | —.00742 | 48 42 13.81 | 4.3436 | 2218 | .012 | —.1240 | 13 | 14 |
| 200 | 6491 | 3.3 | 54 16.088 | 2.24219 | + 134 | .001 | —.00148 | 32 31 9.37 | 4.7073 | 3156 | .023 | +.0029 | | N |
| 201 | 6534 | 5.7 | 19 0 12.139 | + 2.28341 | + 142 | — .000 | +.00417 | 31 33 32.09 | + 5.1369 | + 3199 | — .025 | —.0706 | 9 | 11 |
| 202 | 6579 Pr. | 6.0 | 8 50.808 | 1.55271 | — 286 | .002 | —.01785 | 49 37 16.35 | 6.5555 | 2113 | .022 | +.6214 | 20 | 21 |
| 203 | 6599 | 4.5 | 12 1.813 | 2.07950 | + 102 | .000 | —.00251 | 37 54 43.78 | 6.2136 | 2854 | .026 | +.0140 | | N |
| 204 | 6656 | 6.5 | 19 59.521 | 1.89539 | + 55 | .001 | +.00067 | 43 8 42.92 | 6.8221 | 2569 | .024 | —.0362 | 11 | 13 |
| 205 | 6697 | 3.9 | 26 33.255 | 1.51300 | — 248 | — .002 | +.00108 | 51 27 51.02 | 7.5200 | 2021 | .024 | +.1250 | | N |
| 206 | 6740 | 4.0 | 19 34 26.409 | + 2.36776 | + 108 | + .001 | —.00102 | 29 51 58.67 | + 8.0787 | + 3128 | — .042 | +.0468 | 19 | 20 |
| 207 | 6784 | 5.0 | 41 40.937 | 2 27490 | + 201 | + .001 | .00000 | 33 26 16.24 | 8.1687 | 2959 | .039 | —.4397 | 25 | 27 |
| 208 | 6830 | 6.0 | 48 26.257 | 1.76583 | — 57 | — .001 | —.00267 | 47 36 35.63 | 9.1315 | 2249 | .030 | —.0070 | 17 | 20 |
| 209 | 6876 | 5.7 | 55 24.928 | 1.88461 | + 28 | + .000 | +.00112 | 45 25 54.75 | 9.6580 | 2367 | .033 | —.0197 | 12 | 15 |
| 210 | 6915 | 5.6 | 20 1 43.209 | 2.22602 | + 218 | + .002 | —.02003 | 35 37 44.60 | 9.7303 | 2730 | .044 | —.4269 | 16 | 20 |
| 211 | 6962 | 4.2 | 20 9 22.335 | + 1.88520 | + 39 | + .001 | +.00067 | 46 26 17.74 | +10.7147 | + 2277 | — .036 | —.0141 | | N |
| 212 | 6998 | 5.3 | 13 51.062 | 2.30267 | + 191 | + .002 | —.00035 | 84 35 35.01 | 11.0686 | 2754 | .052 | +.0108 | 14 | 18 |
| 213 | 7037 | 6.0 | 19 32.269 | 0.29206 | — 3835 | — .029 | +.00119 | 68 28 49.72 | 11.5024 | 301 | .077 | +.0330 | 17 | 19 |
| 214 | 7094 | 5.6 | 28 2.298 | 2.83728 | — 88 | + .002 | +.00368 | 12 36 0.59 | 12.1104 | 3257 | .092 | +.0388 | 20 | 18 |
| 215 | 7140 | 4.8 | 32 56.283 | 2.67653 | + 94 | + .003 | +.00244 | 20 45 48.92 | 12.4224 | 8016 | .081 | +.0112 | | N |
| 216 | 7138 | 5.0 | 20 33 0.477 | + 3.07585 | — 440 | + .001 | +.00449 | 0 2 53.76 | +12.4130 | + 3474 | — .117 | —.0029 | 20 | 19 |
| 217 | 7178 | 6.0 | 35 59.559 | — 3.46948 | — 38815 | — .551 | +.01342 | 80 59 35.47 | 12.6219 | — 3971 | .862 | +.0019 | 25 | 25 |
| 218 | 7176 | 6.0 | 37 38.525 | + 1.27918 | — 988 | — .007 | —.00011 | 60 3 18.32 | 12.8991 | + 1386 | .039 | +.1673 | 16 | 14 |
| 219 | 7213 | 4.5 | 42 32.435 | 2.33413 | + 314 | + .004 | —.00011 | 36 1 55.75 | 13.0627 | 2527 | .061 | +.0026 | | N |
| 220 | 7254 | 5.6 | 48 56.674 | 2.09498 | + 309 | + .004 | +.00258 | 44 42 32.10 | 13.4748 | 2207 | .053 | —.0053 | 13 | 15 |

| | B. A. C. | Mg. | $\alpha$ 1875.0 | $\frac{d\alpha}{dt}$ | $\frac{d^2\alpha}{d\beta^2}$ | $\frac{(100)^3}{6}\frac{d^3\alpha}{dt^3}$ | $\mu$ | $\delta$ 1875.0 | $\frac{d\delta}{dt}$ | $\frac{d^2\delta}{d\beta^2}$ | $\frac{(100)^3}{6}\frac{d^3\delta}{dt^3}$ | $\mu'$ | $\frac{A}{\alpha}$ | $\frac{A}{\delta}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | h m s | | | | | ° ′ ″ | | | | | | |
| 221 | 7297 | 6.8 | 20 55 8.805 | + 2.28855 | + 385 | + .005 | +.01945 | 39 45 52.58 | +14.0843 | + 2370 | — .060 | +.2072 | 12 | 15 |
| 222 | 7326 | 7.0 | 59 11.374 | 2.24274 | + 429 | + .005 | —.00089 | 41 8 4.30 | 14.0826 | 2259 | .059 | —.0476 | 16 | 17 |
| 223 | 7380 | 4.1 | 21 9 34.505 | + 2.99964 | — 275 | + .004 | +.00231 | 4 43 55.51 | 14.6840 | + 2900 | .126 | —.0764 | | N |
| 224 | 7438 | 6.0 | 17 2.098 | — 0.54914 | — 13095 | — .195 | +.00906 | 76 29 8.40 | 15.2049 | — 579 | .210 | +.0105 | 15 | 18 |
| 225 | 7509 | 7.3 | 28 59.097 | — 0.17576 | — 10728 | — .162 | —.00016 | 75 51 14.56 | 15.8451 | — 225 | .160 | —.0107 | 14 | 14 |
| 226 | 7522 | 5.8 | 21 32 16.307 | + 3.00552 | — 226 | + .005 | +.00651 | 5 12 30.91 | +16.0611 | + 2570 | — .135 | +.0308 | 19 | 19 |
| 227 | 7561 | 2.5 | 33 2.800 | 2.94569 | — 54 | + .006 | +.00058 | 9 18 9.89 | 16.3381 | 2424 | .129 | +.0093 | | N |
| 228 | 7597 | 5.0 | 41 32.269 | 0.75768 | — 4063 | — .052 | —.01174 | 71 44 50.27 | 16.4609 | 547 | .065 | —.0433 | 21 | 22 |
| 229 | 7610 | 6.7 | 44 48.584 | 1.07425 | — 2310 | — .026 | —.00131 | 69 34 17.31 | 16 6339 | 799 | .050 | —.0313 | 19 | 19 |
| 230 | 7641 | 5.6 | 50 50.663 | 2.92387 | + 73 | + .006 | —.00329 | 11 29 0.62 | 16.9434 | 2202 | .130 | —.0098 | 23 | 18 |
| 231 | B.D.59.2444 | 7.4 | 21 55 23.083 | + 1.87498 | + 629 | + .009 | —.01368 | 59 41 56.30 | +17.1664 | + 1330 | — .048 | +.0044 | 2 | 3 |
| 232 | 7685 | 6.0 | 58 21.651 | 3.08735 | — 444 | + .006 | —.00274 | — 1 30 36.43 | 17.2535 | 2203 | .154 | —.0418 | 22 | 19 |
| 233 | 7712 | 6.0 | 22 1 58.058 | + 2.81316 | + 482 | + .008 | —.00505 | 21 5 42.22 | 17.3875 | + 1942 | .119 | —.0655 | 17 | 18 |
| 234 | 7732 Pr. | 7.5 | 2 36.064 | — 1.82387 | — 41949 | —1.214 | —.07011 | 82 16 2.88 | 17.4382 | — 1430 | .551 | —.0419 | 14 | 20 |
| 235 | *7760 | 6.2 | 7 47.510 | + 1.37936 | — 1001 | — .010 | —.00990 | 69 30 55.01 | 17.7058 | + 863 | .042 | +.0075 | 19 | 22 |
| 236 | 7796 | 5.1 | 22 15 21.940 | + 2.95157 | + 186 | + .008 | +.00006 | 11 34 33.48 | +18.0168 | + 1820 | — .139 | +.0166 | | N |
| 237 | 7820 | 5.0 | 19 27.071 | 2.42089 | 1502 | .015 | —.00164 | 48 50 35.16 | 18.1416 | 1421 | .080 | —.0133 | 21 | 24 |
| 238 | 7843 | 5.5 | 24 18.856 | 2.73673 | 1053 | .011 | +.00236 | 31 55 59.80 | 18.3258 | 1541 | .113 | —.0058 | | N |
| 239 | 7915 | 6.0 | 35 53.019 | 2.67372 | 1478 | .014 | —.00202 | 39 34 22.44 | 18.7157 | 1318 | .107 | —.0029 | 12 | 14 |
| 240 | 7932 | 5.1 | 38 31.178 | 2.66317 | 1578 | .015 | —.00220 | 41 9 49.01 | 18.8149 | 1270 | .106 | +.0148 | | N |
| 241 | 7963 | 6. | 22 44 43.689 | + 2.69296 | + 1680 | + .015 | —.00053 | 41 17 30.61 | +18.9762 | + 1185 | — .110 | —.0061 | 15 | 18 |
| 242 | 7978 | 6.7 | 47 28.894 | 2.72890 | 1638 | .015 | —.00037 | 39 30 12.46 | 19.0465 | 1156 | .114 | —.0121 | 9 | 12 |
| 243 | 8024 | 6.5 | 56 13.899 | 2.51745 | 2636 | .027 | —.00138 | 56 26 3.21 | 19.2766 | 925 | .092 | —.0064 | 14 | 12 |
| 244 | 8052 | 4.5 | 23 1 1.528 | 2.91336 | 1074 | .011 | —.00171 | 24 47 38.07 | 19.3660 | 997 | .140 | —.0279 | 20 | 21 |
| 245 | 8078 | 5.2 | 5 25.566 | 3.02596 | 291 | .009 | —.00173 | 8 2 29 52 | 19.5022 | 957 | .157 | +.0139 | | N |
| 246 | 8122 | 6.8 | 23 13 22.079 | + 2.17376 | + 3954 | + .068 | —.01451 | 73 0 21.60 | +19.6084 | + 552 | — .063 | —.0321 | 15 | 15 |
| 247 | 8195 | 6. | 25 8.838 | 2.93427 | 2146 | .018 | +.02341 | 38 32 58.87 | 19.7497 | 568 | .144 | —.0731 | 25 | 27 |
| 248 | 8229 | 4.3 | 32 0.619 | 2.92399 | 2500 | .020 | +.00139 | 42 34 34.12 | 19.9075 | 434 | .144 | +.0026 | | N |
| 249 | 8252 | 6.5 | 37 0.710 | 2.89691 | 3494 | .031 | —.00112 | 52 27 33.04 | 19.9492 | 337 | .139 | —.0042 | 10 | 10 |
| 250 | 8284 | 6.0 | 43 19.993 | 3.02431 | 1642 | .014 | +.00403 | 28 8 47.79 | 20.0206 | 235 | .159 | +.0194 | 21 | 19 |
| 251 | 8317 | 7.5 | 23 49 18.287 | + 2.97533 | + 4392 | + .041 | —.00191 | 56 42 59.50 | +20.0216 | + 116 | — .151 | —.0108 | 13 | 14 |
| 252 | 8324 | 4.8 | 51 24.502 | 3.04540 | 1476 | .013 | —.00407 | 24 26 47.38 | 20.0143 | + 80 | .163 | —.0258 | | N |
| 253 | 8356 | 7.0 | 56 21.235 | 2.90393 | 19789 | .714 | —.01147 | 82 16 38.46 | 20.0355 | — 19 | .141 | —.0162 | 15 | 15 |
| 254 | 8365 | 6.5 | 23 58 39.339 | 3.07383 | 120 | .010 | +.00142 | — 1 11 50.15 | 20.0000 | — 60 | .167 | —.0539 | 23 | 24 |

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